about **30** degrees Celsius and about 275 degrees Celsius. In some embodiments, the temperature is between about 100 degrees Celsius and about 200 degrees Celsius. In an embodiment, the substrate, e.g., glass layer **820** and conductor layer **830** for depositing film **840**; glass layer **820**, conductor layer **830**, and film **840** for depositing region **863**; and glass layer **820**, conductor layer **830**, film **840**, and region **863** for depositing region **862**, is not externally heated. Thus, the temperature of the substrate is generally equal to the temperature of the chamber plus minor heating effects of depositing the film. In contrast to prior methods for fabricating layers having sufficient quality such that the cell approaches about 10 percent efficiency, an embodiment of the present invention does not heat the substrate. Accordingly, manufacturing efficiencies are achieved while maintaining sufficient efficiency. It is believed that some embodiments of the present invention will have conversion efficiencies of greater than about **5** percent. It is believed that some embodiments of the present invention will have conversion efficiencies of greater than about 6 percent. It is believed that some embodiments of the present invention will have conversion efficiencies of greater than about 7 percent. It is believed that some embodiments of the present invention will have conversion efficiencies of greater than about 8 percent. It is believed that some embodiments of the present invention will have conversion efficiencies of greater than about 9 percent. It is believed that some embodiments of the present invention will have conversion efficiencies of greater than about 10 percent. It is believed that some embodiments of the present invention will have conversion efficiencies of greater than about 11 percent.

[0189] Other embodiments for fabricating energy conversion devices, such as a photovoltaic cell **800**, are fabricated according to many of the embodiments described herein with reference to energy storage devices. The thin films of the energy conversion devices are improved in a similar manner as described herein for the thin films of energy storage devices.

[0190] In contrast to some conventional methods for improving performance of a photovoltaic cell, the present methods can produce photovoltaic cells having an enhanced conversion efficiency without heat treating during deposition, e.g., heating the substrate, or a post-deposition high temperature anneal.

[0191] **FIG. 9A** shows a thin-film energy-storage device **910A** according to the teachings of the present disclosure and an integrated circuit **940**, here shown as a "flip chip". Energy-storage device **910A** includes substrate **920** on which is formed a patterned wiring layer **922**. The wiring layer **922** is an electrically conductive layer for connecting energy-storage device **920** to the integrated circuit **940**. In some embodiments, layer **922** is formed of a metal. In one embodiment, the wiring layer **922** is patterned copper. In another embodiment, the wiring layer is formed of nickel. In other embodiments, the wiring layer is formed of a noble metal. Wiring layer **922** includes a cathode wiring pattern **922A** and an anode wiring pattern **922B**, which are separate from each other and form opposite polarity connectors **923A** and **923B** to external circuitry, such as integrated circuit **940**. Device **910A** further includes a cathode contact film **924** formed on at least a portion of cathode wiring pattern **922A** and an anode contact film **926** formed on at least a portion of the anode wiring pattern **922B**. A cathode film **927** is formed on the cathode contact film **924** according to the teachings herein. An electrolyte film **928** is formed over the cathode film **926**, cathode contact film **924** and a portion of the cathode-wiring pattern **922A**. Electrolyte film **928** separates the cathode films **922A**, **924** and **927** from respective anode films **922B**, **926** and **932**. Anode film **932** is formed on the electrolyte film and in contact with the anode contact film **926** according to the teachings herein. It will be appreciated that, in one embodiment, cathode contact film **924** and cathode wiring pattern **922A** are formed as a single layer. It will be further appreciated that, in one embodiment, anode contact film **926** and anode wiring pattern **922B** are formed as a single layer. A passivation layer **934** is formed over all of the films except portions **923A** and **923B** of the wiring patterns **922A** and **923B**, which portions are left exposed. Passivation layer **934** protects the films from contact to other layers, which may be formed on substrate **920**, and the environment, which may include elements that may react with and damage the films of the energy-storage device **910A**.

[0192] In some embodiments, the cathode materials and other materials used in the batteries above include materials discussed more in N.J. Dudney et al, "Nanocrystaline $Li_xMn_{1y}O_4$ Cathodes for Solid-State Thin-Film Rechargable Lithium Batteries," Journal of the Electrochemical Society, 146(7) 2455-2464 (1999) which is incorporated by reference.

[0193] The integrated circuit **940** includes a first ball contact **941** and a second ball contact **942** both extending outside a package. The first ball contact **941** aligns with the exposed portion **923A** of the cathode wiring pattern **922A**. The second ball contact **942** aligns with the exposed portion **923B** of the anode wiring pattern **922B**. Integrated circuit **940** is positioned so that the ball contacts **941** and **942** physically and electrically contact the wiring contacts **923A** and **923B**, respectively. Integrated circuit **940** is fixed in position relative to the device **910A** such that device **910A** provides electrical energy to circuit **940**. In some embodiments, circuit **940** is provided with circuitry for recharging energy-storage device **910A**. It will be recognized that the present invention is not limited to only integrated circuit **940** being connected to wiring contacts **923A** and **923B**. Other circuits, including integrated circuits fabricated on substrate **920** and circuits with leads connected to wiring contacts **923A** and **923B**, are within the scope of the present invention.

[0194] **FIG. 9B** shows another embodiment of the thin-film energy-storage device **910B**, substantially similar elements to those described above are designated by the same reference numerals. After forming wiring patterns **922A**, **922B**, an insulator layer **930** is formed on the substrate **920**. Insulator layer separates the thin-film energy-storage device **910** from other layers that may be included with substrate **920**. Insulator layer **930** includes vias **931** through which cathode contact film **924** and anode contact film **926** extend downward to connect to cathode contact wiring pattern **922A** and anode wiring pattern **922B**, respectively.

[0195] In one example of an energy-storage device **910** according to the present invention, the cathode film **927** is a $LiCoO_2$ deposited using a first source of LiCoO with a secondary source of oxygen. The electrolyte film **928** is LiPON deposited using a first source of LiPO (such as